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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/083,877	02/25/2002	Alan Wong	10559/591001/P12772	4750
20985	7590	11/07/2003	EXAMINER	
FISH & RICHARDSON, PC 12390 EL CAMINO REAL SAN DIEGO, CA 92130-2081			MEYER, DAVID C	
			ART UNIT	PAPER NUMBER

2878

DATE MAILED: 11/07/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/083,877	WONG ET AL.	
	Examiner	Art Unit	
	David C. Meyer	2878	

-- *Th MAILING DATE of this communication appears on the cover sheet with the correspond nce address --*
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED. (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 February 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-90 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21, 24-31, 33, 35-41, 45-48, 51-58, 60, 62-80 and 84-89 is/are rejected.
- 7) ☒ Claim(s) 22, 23, 32, 34, 42-44, 49, 50, 59, 61 and 81-83 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 February 2002 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>0602</u> . | 6) <input type="checkbox"/> Other: |

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the first and second measuring means recited in claims 84 and 90 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

2. Claim 33 is objected to because of the following informalities: Line 2 omits the word "structure" following the word "periodic". Appropriate correction is required.

Claim 38 is objected to because it appears to depend from the wrong claim. Claim 31 does not mention a fourth pitch. The examiner believes claim 38 should depend from claim 36 or 37.

Claims 84 and 90 are objected to because it claims an "optical metrology target comprising a first means for measuring ... and a second means for measuring". Claim 84 is directed to an integrated circuit that comprises an optical metrology target, not to an apparatus. It is unclear how an optical metrology target can comprise means for measuring an optical metrology target.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-3, 5, 7, 10, 11, 18, 19, 24-31, 33, 35, 36, 39, 41, 45-48, 51-58, 60, 62, 63, 73, 78 and 80 are rejected under 35 U.S.C. 102(e) as being anticipated by Niu (US 6,433,878).

Regarding claims 1 and 45, Niu discloses an optical metrology target comprising an array of grating patterns 81-110 (Fig. 15). This array of grating patterns is formed during a photolithographic exposure process. The array includes first and second periodic patterns having first and second pitches, respectively. The grating patterns are measured using an ellipsometer 124. Measuring involves illuminating the gratings with a light source 125 and receiving scattered light with a light detector 126. A CPU 130 analyzes the received optical signal. (See column 10, lines 8-58.)

Regarding claims 2 and 3, Nie discloses that each grating is assigned a 2-D profile which includes a determined pitch. Hence, Niu determines the pitches of the respective gratings (column 10, lines 61-67).

Regarding claim 5, the ellipsometric measuring process does not in any way destroy the grating patterns.

Regarding claim 7, light source 125 is a broadband light source and hence, non-coherent.

Regarding claims 8 and 9, Niu discloses that typical ellipsometers use broadband Xenon lamps in the 200-900 nm range, which includes infrared, visible, and ultraviolet light (column 7, lines 57-60).

Regarding claim 10, a CPU 130 analyzes the received optical signal using programmed instructions (column 10, lines 43-46).

Regarding claims 18, 19, and 62, Fig. 19 shows a multilayer object that is formed during exposure using the grating array mentioned above. First and second periodic structures are formed during exposure and have first and second pitches (L2 and 250 microns) respectively. In the Background of the Invention section, Niu describes a photolithographic process by which microcircuits are formed. The object shown in Fig. 19 appears to be such a microcircuit device, and the gate oxide layer constitutes an electrical element and a conductive structure.

Regarding claims 11 and 63, Fig. 15 of Niu shows a test pattern area that stands alone from the array of grating patterns 81-110.

Regarding claims 24 and 51, grating patterns 81-110 are located adjacent to one another (Fig. 15).

Regarding claims 25-27 and 52-54, Fig. 18 shows a "biperiodic" pattern in which a first periodic pattern, consisting of groups of features 142, 150, and 152, overlaps a

repeating second periodic pattern, consisting of individual features 142, 150, and 152.

The axes of the first and second pattern are parallel and aligned.

Regarding claims 28, 29, 55, and 56, the first and second patterns share features 142, 150, and 152. The shared features are aligned.

Regarding claim 30 and 57, because features 142, 150, and 152 are shared by the optical patterns, at least one feature of the first pattern is connected to a feature of the second pattern.

Regarding claim 31 and 58, feature 142 is nested between features 150 and 152.

Regarding claim 33 and 60, Niu discloses as prior art example (Fig. 7) a photomask with two periodic patterns, including a dense pattern and a pattern of "isolated" features.

Regarding claims 35 and 73, Niu features an array of grating patterns 81-110. This includes third and fourth periodic structures, each with their own pitch. The ellipsometric measuring process is carried out for all grating patterns (column 10, lines 61-67), and the CPU 130 analyzes optical signals from each pattern, generating a profile that includes a pitch determination.

Regarding claim 36, Niu discloses as a prior art example (Figs. 9 and 12) a wafer 50 on which a plurality of periodic patterns are formed. In Fig. 12 the blocks 55 represent the series of patterns 35 pictured in Fig. 9. A first row of the blocks 55 are aligned along a first axis. A second row of the blocks 55 (not shown) would be aligned along a second, parallel axis. Each of these first and second axes would comprise at least two periodic patterns as evidenced by the multiplicity of patterns in series 35.

Regarding claim 39 and 78, Fig. 18 shows features having a rectilinear shape.

Regarding claim 41 and 80, Fig. 19 shows a multilayer object that is formed during exposure using the grating array mentioned above. First and second periodic structures are formed during exposure and have first and second pitches (L_2 , 250 microns) respectively. These structures are pictured as being located in a first, upper layer of the formed object.

Regarding claim 46, Fig. 18 shows first and second features having both a length and a width.

Regarding claims 47 and 48, Fig. 25 shows a repeating series of periodic patterns. All features have the same width and length.

5. Claims 84 and 85 are rejected under 35 U.S.C. 102(b) as being anticipated by Ausschnitt (US 6,130,750).

Regarding claims 84 and 85, Ausschnitt discloses a metrology tool used to examine features of a substrate formed during a lithographic process. In the Background of the Invention section, Ausschnitt states that the field of invention relates to devices for monitoring products of lithographic and etch processes in microelectronics manufacturing, which would include integrated circuits. Fig. 17 shows a substrate comprising device areas, which in a microelectronics device would necessarily include electrical elements, and standalone test pattern areas 40. The test pattern areas 40 constitute a metrology target having first and second periodic structures each having a pitch.

Claim Rejections - 35 USC § 103

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 4, 6, 12-17, 20, 21, 67, 37, 38, 68-72 are rejected under 35 U.S.C. 103(a) as being unpatentable over Niu (US 6,433,878).

Regarding claim 4, Niu does not disclose that the CPU 130 performs a simultaneous determination of first and second pitches. However, it is well known to perform many execute a program that performs multiple calculations simultaneously in order to reduce a processing time. It would have been obvious to one of ordinary skill in the art to configure the CPU in Niu to perform a simultaneous pitch determination during the assigning of grating profiles in view of the desired process speed vs. system cost considerations.

Regarding claim 6, Niu describes in the Background of the Invention section a conventional scatterometry arrangement that uses a single wavelength laser (column 6, lines 54-58). Although Niu discloses an embodiment which uses a broadband light source, it is clearly known to use a coherent light source to perform metrology measurements. It would have been obvious to one of ordinary skill in the art at the time of invention to use a coherent light source to perform metrology measurements because it is well known to do so.

Regarding claims 12-16, Niu does not state that the array of grating patterns 81-110 mimics an electrical element, a circuit structure, a conductive structure, an insulated structure, or a flash memory array. However, the grating patterns 81-110 constitute a photomask used in a photolithographic process for fabricating computer chips or microcircuits (Background of Invention section). All of the aforementioned structures are well known components of computer chips and microcircuits. The grating patterns must mimic the circuit structures they are used to form. Which of the aforementioned structures the patterns mimicked would have been obvious to one of ordinary skill in the art at the time of invention in view of the characteristics of the microcircuit being produced.

Regarding claims 17, 20-21, and 67, Niu does not state that the device pictured in Fig. 19 comprises two or more electrical elements, a memory device element, or a logic device element. As stated above, the device pictured in Fig. 19 appears to be a microcircuit device. Electrical elements, memory device elements, and logic device elements are well known components of computer chips and microcircuits. The specific

structures incorporated into the device of Fig. 19 would have been obvious to one of ordinary skill in the art at the time of invention in view of the characteristics of the microcircuit being made.

Regarding claims 37 and 38, the gratings 81-110 are shown in Fig. 15 as being aligned on single axis. However, Niu discloses as a prior art example (Fig. 12) a wafer 50 on which are exposed a series of periodic patterns 35. The series of patterns appears more than once on the wafer 50 such that a plurality of alignment axes, all parallel, can be identified. Furthermore, as stated above, Niu discloses that for each of the gratings 81-110, a profile is generated, following an ellipsometric measurement, which includes pitch information (column 10, lines 61-67). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time of invention to determine the pitches of third and fourth periodic patterns that are aligned along a second axis.

Regarding claims 68-72, as stated in the section containing 35 U.S.C. 102 rejections (claims 24, 25, 27, 28, and 30), Niu discloses an array of grating patterns wherein a first and a second periodic pattern are adjacent, overlap, share a feature, have features that are aligned, and have features that are connected (Figs. 15 and 18). Because these grating patterns are used in the production of the device pictured in Fig. 19, it follows that patterns of the device would also be adjacent, overlap, share features, have features that are aligned, and/or have features that are connected. The specific arrangement of the patterns in the device of Fig. 19 would have been obvious to one of

ordinary skill in the art in view of the specific manner of microcircuit device being produced.

9. Claims 40 and 79 rejected under 35 U.S.C. 103(a) as being unpatentable over Niu (US 6,433,878), as applied to claims 1 and 62 under 35 U.S.C. 102(e), in view of Ausschnitt (US 6,130,750). Niu does not disclose that grating patterns may comprise curvilinear features. It is well known to use curvilinear features during photolithographic and metrology processes, as taught by Ausschnitt. In his disclosure, Ausschnitt states, "The patterns being developed in semiconductor technology are generally in the shape of lines both straight and with bends" (column 1, lines 57-59). It would have been obvious to one of ordinary skill in the art at the time of invention to use curvilinear features in view of the specific manner of device being manufactured or measured.

10. Claims 74-77 are rejected under 35 U.S.C. 103(a) as being unpatentable over Niu, as applied to claim 73 under 35 U.S.C. 102(e), in view of Ausschnitt. The array of grating patterns 81-110 is apparently oriented along a single axis (Fig. 15). The periodic structures on the device pictured in Fig. 19 are also apparently oriented along a single axis. It is well known to orient periodic structures in an optical target along more than one axis as taught by Ausschnitt. Fig. 17 of Ausschnitt shows such an arrangement, as does Fig. 18. The orientation of the grating patterns of Niu, whether along a single or multiple axes, would have been obvious to one of ordinary skill in the art in view of the device or photomask being manufactured and used. Regarding the determination of third and fourth pitches, as stated previously, Niu discloses that ellipsometric

measurements are performed for each grating in the array and that a profile including a pitch is generated for each grating.

11. Claims 62-66 and 86-89 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ausschnitt.

Regarding claims 62 and 63, Ausschnitt discloses a metrology tool used to examine features of a substrate formed during a lithographic process. In the Background of the Invention section, Ausschnitt states that the field of invention relates to devices for monitoring products of lithographic and etch processes in microelectronics manufacturing, which would include integrated circuits. Fig. 17 shows a substrate comprising device areas, which in a microelectronics device would necessarily include electrical elements, and standalone test pattern areas 40. The test pattern areas 40 constitute a metrology target having first and second periodic structures each having a pitch. Ausschnitt does not disclose that these periodic structures have different pitches. In fact, the pitches appear to be the same for each structure. However, Fig. 18 of Ausschnitt shows an overlay target comprising periodic structures having different pitches. Structures 135 and 154, for example, have different pitches. Given that microelectronics devices often combine several types of structure on a single substrate it would have been obvious to one of ordinary skill in the art at the time of invention to form an optical metrology target on an integrated circuit that comprised periodic structures having different pitches.

Regarding claims 64, 65, and 86-88, Ausschnitt does not disclose that the test pattern 40 mimics an electrical element, a circuit structure, or a memory device element.

However, in order for the test pattern to have utility, it must mimic, at least with regard to scale, the device features which are printed on the substrate. In fact, Ausschnitt states that "to represent the product, the elements of the test pattern should have a width and pitch smaller than or equal to (corresponding to) that of the most critical feature of the device pattern" (column 13, lines 57-60). Which type of microcircuit structures the test pattern mimicked would have been obvious to one of ordinary skill in the art at the time of invention in view of the specific manner of device being manufactured.

Regarding claims 66, 67, and 89, Fig. 17 does not illustrate the particulars of the device pattern. Ausschnitt does not disclose how many electrical elements the device area contains. The number of electrical elements incorporated would have been obvious to one of ordinary skill in the art at the time of invention in view of the specific manner of device being manufactured.

Allowable Subject Matter

12. Claims 22, 23, 32, 34, 42-44, 49, 50, 59, 61, and 81-83 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The following is a statement of reasons for the indication of allowable subject matter: Regarding claims 22, 23, 49, and 50, the prior art of record does not disclose or suggest the invention as claimed, specifically wherein a first feature width or a first pitch is less than 100 nanometers. Regarding claims 32 and 59, the prior art or record does not disclose or suggest the invention as claimed, specifically wherein in a nested arrangement of first and second periodic structures a line-to-space ratio of the features

of the first periodic structure comprises a value less than 1:3. Regarding claims 34 and 61, the prior art of record does not disclose or fairly suggest the invention as claimed, specifically wherein in an arrangement in which a second periodic structure comprises isolated features, a line-to-space ratio of the features of the second periodic structure exceeds 1:3. Regarding claims 42-44 and 81-83, the prior art of record does not disclose or suggest the invention as claimed, specifically wherein a second optical metrology target is provided in a second layer of a device, the second target comprising third and fourth periodic structures having different pitches.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Stirton (US 6,529,282) discloses a method for performing scatterometric measurements on periodic structures in a semiconductor device. Li (US 6,327,035) discloses an apparatus for optically measuring features in an integrated circuit or semiconductor device.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David C. Meyer whose telephone number is 703-305-7955. The examiner can normally be reached on M-F 8:30-5:30.

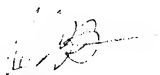
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David P. Porta can be reached on 703-308-4852. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0935.

DCM
October 22, 2003


DAVID PORTA
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER